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## STANDARD TESTS AS AN AID TO SUPERVISION

HENRY A. LANE  
Houghton, Michigan

During the latter part of October, 1913, the writer conducted the Courtis standard tests in arithmetic (Series B) consisting of four tests, one in each of the four operations, with a time allowance of six minutes for multiplication, four minutes for subtraction, and eight minutes for each of the other operations. The subjects were about five hundred pupils distributed in thirty-five classes in four schools in Houghton, Michigan. The results of the test for each class were tabulated and graphed; but as this gave groups that were too small, tabulations and graphs were made for the system as a whole, thus giving ten groups of approximately fifty individuals each. These results are shown in the accompanying graphs and table (Table I and Charts I and II). The abscissas represent the grades from 4B to 8A and the ordinates represent the number of examples. Full lines indicate the number of examples attempted and dotted lines the number of examples right.

Taking the curves for addition, it seemed a singular comment on the efficiency of our educational system that four years of arithmetic teaching should increase a child's score in attempts from 4.5 to 9.2, rights from 1.1 to 4.0, and in accuracy from 24 per cent to 43 per cent; that is, an 8A child can do only 5 more examples in 8 minutes than a 4B child, can get only 3 more right, and can work only 20 per cent more accurately. Furthermore, the shape of the curves indicated a very uneven development of ability through the school course.

These were the facts. What was to be done? Knowing what some of the best of the thirty-five classes tested had done, a curve was drawn for the number of addition examples attempted, allowing for a growth of from 5 examples in the the 4B grade to 12 examples in the 8A grade, and a curve for the number of examples right was constructed ranging from 2 examples in the 4B grade to 10 examples in the 8A grade; the growth in accuracy is thus from

TABLE I

GRADE	SOURCE OF SCORE	No. of PUPILS	ADDITION			SUBTRACTION			MULTIPLICATION			DIVISION		
			Attempts	Rights	Percent- age of Accuracy	Attempts	Rights	Percent- age of Accuracy	Attempts	Rights	Percent- age of Accuracy	Attempts	Rights	Percent- age of Accuracy
4B....	{October, 1913... June, 1914... (Standard).....	{44 49 .....	4.5	1.1	24	4.5	0.8	18	3.0	0.9	30	2.6	0.7	27
			4.9	3.1	63	4.4	1.8	41	4.2	4.2	62	4.0	1.6	40
			5.0	2.0	40	5.0	2.0	40	4.0	1.6	40			
4A....	{October, 1913... June, 1914... (Standard).....	{44 52 .....	4.2	1.3	31	5.7	3.2	56	4.8	2.4	50	3.3	1.2	36
			5.7	2.4	42	5.5	3.4	62	4.4	2.9	66	3.3	1.6	48
			5.7	2.9	51	5.7	2.9	51	4.9	2.4	49	4.9	2.4	49
5B....	{October, 1913... June, 1914... (Standard).....	{60 49 .....	7.0	1.9	27	6.6	3.5	53	4.9	2.3	47	3.9	1.2	31
			8.0	4.9	61	7.7	6.3	82	6.2	4.3	69	4.8	3.2	67
			6.5	3.8	58	6.5	3.8	58	5.8	3.4	59	5.8	3.4	59
5A....	{October, 1913... June, 1914... (Standard).....	{50 53 .....	7.1	2.3	32	7.8	3.3	42	5.4	2.5	46	4.1	2.0	49
			7.9	4.0	51	8.7	6.7	77	6.5	3.9	60	5.9	4.7	80
			7.3	4.7	64	7.3	4.7	64	6.6	4.4	67	6.6	4.4	67
6B....	{October, 1913... June, 1914... (Standard).....	{48 58 .....	7.0	2.3	33	7.5	4.6	61	6.1	2.6	43	4.0	1.5	38
			10.1	6.8	67	10.0	7.6	76	8.4	6.1	73	7.4	5.9	80
			8.0	5.6	70	8.0	5.6	70	7.5	5.3	71	7.5	5.3	71
6A....	{October, 1913... June, 1914... (Standard).....	{60 48 .....	8.3	3.4	41	8.6	5.1	59	7.0	3.5	50	4.4	2.6	59
			9.7	6.0	62	10.3	8.0	78	8.6	5.3	62	8.0	5.7	71
			8.8	6.5	74	8.8	6.5	74	8.4	6.2	74	8.4	6.2	74
7B....	{October, 1913... June, 1914... (Standard).....	{68 55 .....	8.6	3.4	40	9.5	6.0	63	7.9	4.1	52	6.6	4.6	70
			10.9	6.2	57	10.9	8.4	77	9.0	6.1	68	7.5	5.7	79
			9.6	7.4	77	9.6	7.4	77	9.3	7.2	77	9.3	7.2	77
7A....	{October, 1913... June, 1914... (Standard).....	{44 72 .....	8.7	3.7	43	10.8	6.5	60	7.9	3.8	48	6.7	4.3	64
			11.3	7.5	66	12.8	9.9	77	10.8	8.1	75	12.3	10.1	82
			10.4	8.2	79	10.4	8.2	79	10.1	8.1	80	10.1	8.1	80
8B....	{October, 1913... June, 1914... (Standard).....	{46 43 .....	8.0	3.1	39	11.5	7.2	63	9.4	4.4	47	8.5	5.7	67
			12.4	8.8	71	13.3	11.3	85	10.9	8.2	75	10.3	9.0	87
			11.2	9.1	81	11.2	9.1	81	11.0	9.0	82	11.0	9.0	82
8A....	{October, 1913... June, 1914... (Standard).....	{36 44 .....	9.2	4.0	43	13.0	7.4	57	10.5	5.3	50	10.0	6.4	64
			12.3	7.6	62	13.5	11.3	84	11.5	8.3	72	12.7	10.0	79
			12.0	10.0	83	12.0	10.0	83	12.0	10.0	83	12.0	10.0	83

CHART I

HOUGHTON, MICH. 523 PUPILS

Addition

Subtraction

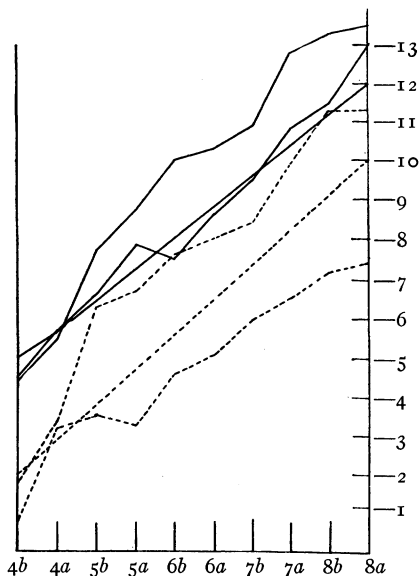
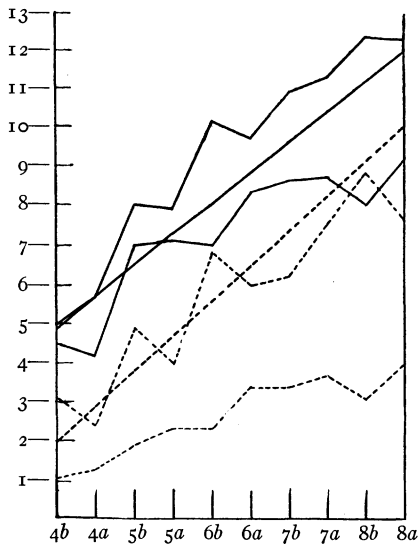
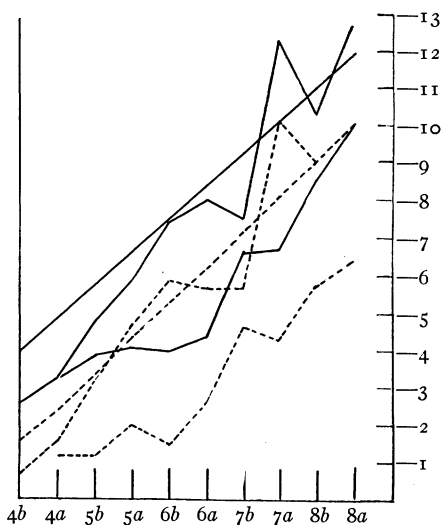
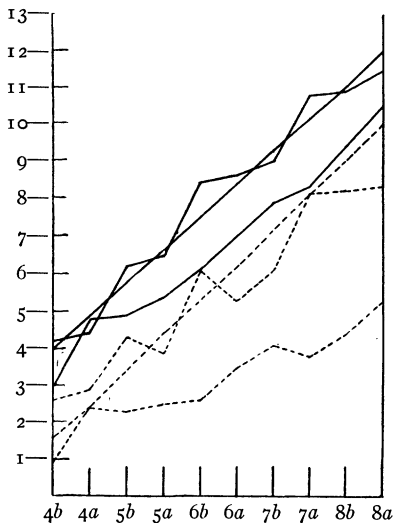


CHART II

HOUGHTON, MICH. 523 PUPILS

Multiplication

Division



40 per cent to 83 per cent. To insure a uniform development throughout the grades, these curves were drawn as straight lines, and the scores for each grade were plotted from the curves. This gave goals to be attained by each grade at the expiration of the school year. Similar tentative standard curves were drawn for the other operations. The pupils as well as the teachers were informed what the standards are so that all could co-operate toward attaining them. Periodical tests similar in construction to the Courtis tests but with modifications in the time allotment were made a feature of the arithmetic course of study, the children keeping a record of their scores and watching their growth; and it was hoped that in June, 1914, the tentative standards would in the majority of the grades be attained. The writer was of the opinion that the inefficiency of arithmetic instruction was not due to faulty method so much as to the fact that teachers and pupils did not know definitely what was expected of them. He therefore placed in the hands of each teacher a copy of the following announcement:

In June there will be another Courtis test of the same type as the one given in October. At that time, the grades are expected to attain the following standards:

	ADDITION AND SUBTRACTION		MULTIPLICATION AND DIVISION	
	Attempts	Rights	Attempts	Rights
4B.....	5.0	2.0	4.0	1.6
4A.....	5.7	2.9	4.9	2.4
5B.....	6.5	3.8	5.8	3.4
5A.....	7.3	4.7	6.6	4.4
6B.....	8.0	5.6	7.5	5.3
6A.....	8.8	6.5	8.4	6.2
7B.....	9.6	7.4	9.3	7.2
7A.....	10.4	8.2	10.1	8.1
8B.....	11.2	9.1	11.0	9.0
8A.....	12.0	10.0	12.0	10.0

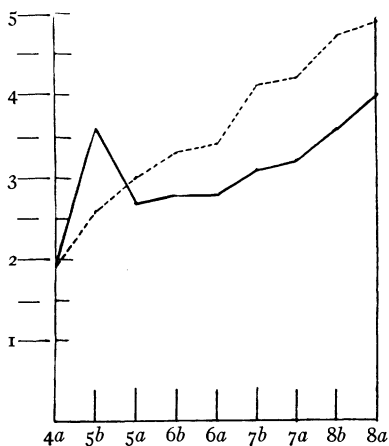
Work in the four operations must be stressed. These are tentative and minimum standards. They will very likely be raised next fall. The success with which classes achieve these standards will, in a sense, be a measure of teaching ability.

At the close of the school year in June, 1914, another measurement was made and the results were very gratifying, as can be seen by examining Table I and graphs (Charts I and II). The straight

CHART III

HOUGHTON, MICH., GROWTHS. 405 PUPILS, OCTOBER, 1913, TO JUNE, 1914

Addition



Subtraction

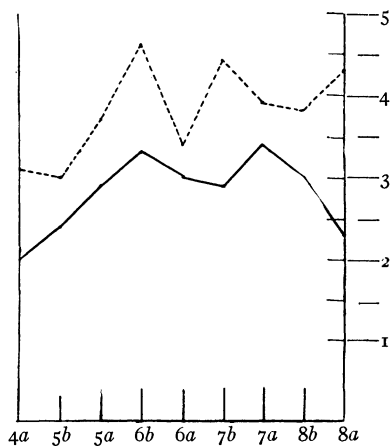
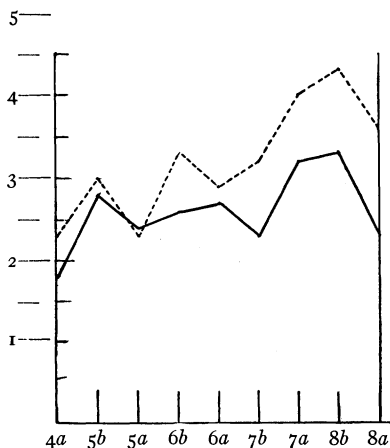


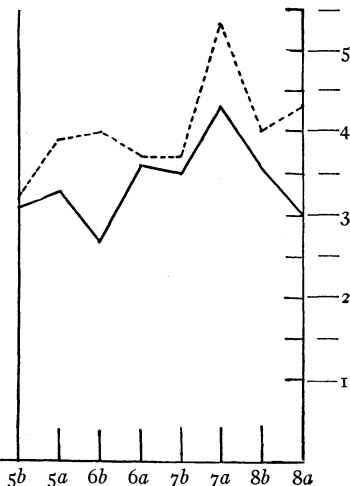
CHART IV

HOUGHTON, MICH., GROWTHS. 405 PUPILS, OCTOBER, 1913, TO JUNE, 1914

Multiplication



Division



lines are the tentative standards, the lower curves are the October results, and the upper curves the June results. The graphs speak for themselves and they tell an instructive story. With very few exceptions, the standards set were attained and in some cases they were exceeded. It is interesting to note that the accuracy of subtraction and division is much greater than that of addition and multiplication. But the essential thing is that the June results were a remarkably close approximation to the tentative standards. One feels almost like stating as a proposition capable of demonstration that reasonable standards can in a very short time be attained.

A tabulation was now made of the growths from October to June, with the results shown in Table II and the accompanying

TABLE II  
ADVANCE OF 405 PUPILS FROM OCTOBER, 1913, TO JUNE, 1914

GRADE	ADDITION			SUBTRACTION			MULTIPLICATION			DIVISION		
	No.	Attempts	Rights	No.	Attempts	Rights	No.	Attempts	Rights	No.	Attempts	Rights
4A.....	39	1.9	1.9	40	2.0	3.1	35	1.8	2.3	.....	.....	.....
5B.....	37	3.6	2.6	37	2.4	3.0	37	2.8	3.0	30	3.1	3.2
5A.....	46	2.7	3.0	46	2.9	3.7	46	2.4	2.3	46	3.3	3.9
6B.....	49	2.8	3.3	51	3.3	4.6	51	2.6	3.3	50	2.7	4.0
6A.....	41	2.8	3.4	41	3.0	3.4	41	2.7	2.9	41	3.6	3.7
7B.....	44	3.1	4.1	44	2.9	4.4	43	2.3	3.2	44	3.5	3.7
7A.....	65	3.2	4.2	65	3.4	3.9	66	3.2	4.0	66	4.3	5.3
8B.....	40	3.6	4.7	40	3.0	3.8	40	3.3	4.3	39	3.6	4.0
8A.....	39	4.0	4.9	40	2.3	4.3	39	2.3	3.6	40	3.0	4.3

graphs (Charts III and IV). Note that every grade showed growths in every operation and that the growth in rights exceeded the growth in attempts. Speaking roughly, the 405 pupils in a school year showed a growth of 3 examples in each of the four operations.

But there is also a dark side to the story. Table III and the corresponding graphs (Charts V and VI) show the individual growths by numbers and by percentages and display the wide variation. Thus in subtraction, 43 pupils, or 16 per cent of the group, suffered actual losses in speed and 26 pupils, or 6 per cent,

TABLE III  
ADVANCE FROM OCTOBER, 1913, TO JUNE, 1914

SCORE	ADDITION				SUBTRACTION				MULTIPLICATION				DIVISION			
	ATTEMPTS		RIGHTS		ATTEMPTS		RIGHTS		ATTEMPTS		RIGHTS		ATTEMPTS		RIGHTS	
	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage	No.	Per-centage
13.....	1	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
12.....	1	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	3	1
11.....	.....	.....	4	1	1	.....	3	1	.....	.....	.....	.....	.....	.....	4	1
10.....	.....	.....	6	2	1	.....	5	1	.....	.....	.....	.....	.....	.....	5	2
9.....	3	1	3	1	3	1	4	1	.....	.....	.....	.....	.....	.....	10	3
8.....	.....	.....	13	3	6	2	16	4	.....	.....	.....	.....	.....	.....	20	6
7.....	12	3	17	4	14	4	25	6	4	1	18	5	22	6	20	6
6.....	30	8	34	9	10	3	27	7	13	3	33	8	25	7	22	6
5.....	32	8	44	11	25	6	36	9	19	5	36	9	28	8	42	11
4.....	50	13	56	14	59	15	63	16	45	11	47	12	44	12	44	12
3.....	65	16	49	12	55	14	67	17	81	20	61	15	61	17	52	14
2.....	76	19	62	15	85	21	62	15	90	23	77	19	51	15	42	11
1.....	65	16	45	11	63	16	44	11	74	19	60	15	59	17	49	13
0.....	35	9	37	9	35	9	23	6	42	11	40	10	23	7	30	8
-1.....	16	4	17	4	19	5	15	4	17	4	15	4	12	3	7	2
-2.....	5	1	12	3	8	2	5	1	8	2	3	1	5	1	5	2
-3.....	5	1	.....	.....	7	2	4	1	.....	.....	2	.....	3	1	2	1
-4.....	.....	.....	1	.....	5	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
-5.....	1	.....	.....	.....	3	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
-6.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	398	.....	402	.....	402	.....	495	.....	398	.....	401	.....	353	.....	359	.....

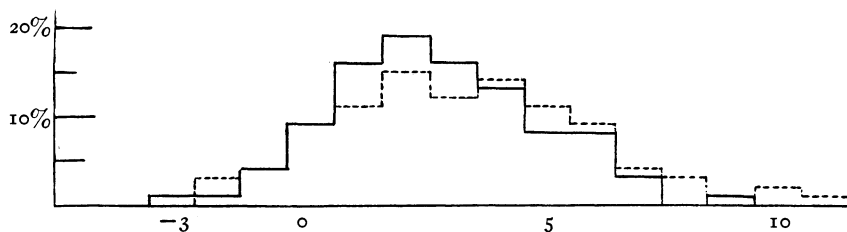


## CHART V

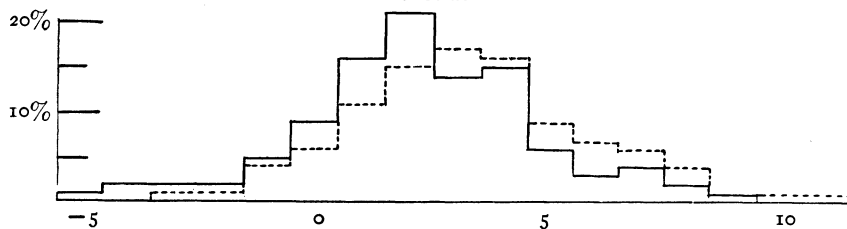
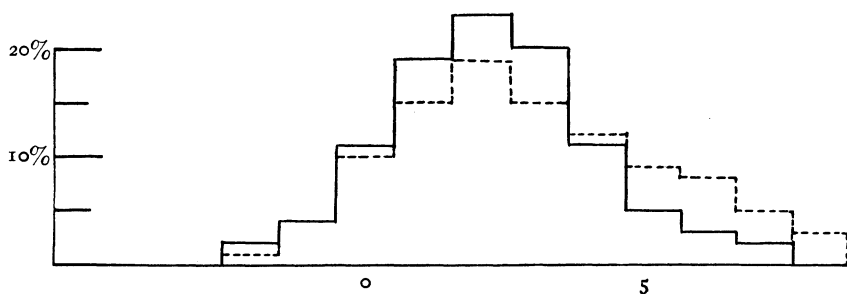
GROWTHS. 405 PUPILS, OCTOBER, 1913, TO JUNE, 1914

Full lines, attempts; dotted lines, rights

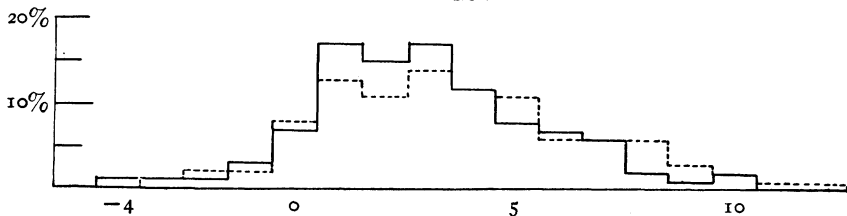
Addition



Subtraction

CHART VI  
Multiplication

Division



suffered losses in accuracy; 35 pupils, or 9 per cent, made no change in speed and 23 pupils, or 6 per cent, no change in accuracy. From 80 to 85 per cent of the group made growths varying from one to eleven examples. There is no reason why everyone who is not mentally deficient should not grow in speed and accuracy, and the problem to be attacked during the current school year is the attainment of standard scores by every individual.